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(71) Applicant *(for all designated States except US)*: GEMSTAR DEVELOPMENT CORPORATION [US/US]; 135 North Los Robles #870, Pasadena, CA 91101 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: MANKOVITZ, Roy, J. [US/US]; 18057 Medley Drive, Encino, CA 91316 (US).

(74) Agent: RAHN, LeRoy, T.; Christie, Parker & Hale, LLP, P.O. Box 7068, Pasadena, CA 91109–7068 (US).

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(54) Title: METHOD AND APPARATUS FOR TIME-SHIFTING VIDEO AND TEXT IN A TEXT-ENHANCED TELEVISION PROGRAM

(57) Abstract

A television system allows a viewer of a text–enhanced television program to pause the program at a particular frame, browse the enhancements at his or her leisure, and then resume viewing the program from that frame, without losing continuity of the video and enhancement portions of the program or program content. This is accomplished by time–shifting the television program for later playback.

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METHOD AND APPARATUS FOR TIME-SHIFTING VIDEO AND TEXT IN A TEXT-ENHANCED TELEVISION PROGRAM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of provisional patent application serial no. 60/044,161, filed April 21,1997, and provisional patent application serial no. 60/052,248, filed July 11, 1997, the disclosures of which are hereby fully incorporated by reference.

BACKGROUND

The present invention is a system wherein television program-related information (PRI) is embedded in the vertical blanking interval (VBI) of a television signal for display on a viewer's television screen at the same time as the television program. The PRI is typically contained in an Internet site, the addresses for which are embedded in the television signal. The Internet site addresses may also be transmitted synchronously with, but separate from the video portion, e.g., via an interface device such as a telephone or cable modem. Typically such an "enhanced" television program consists of a display with the video portion of the program in a picture-in-picture (PIP) window and the PRI in the remaining portion of the display area of the television screen.

This PRI may be any textual or graphic information associated with the current television program. The PRI may consist of a textual display of a World Wide Web (WWW) or other Internet site address to which the viewer can choose to link to through a connection with an Internet Service Provider. Alternatively, the PRI may be contained in one or more Web pages, the addresses of which are inserted into the vertical blanking interval (VBI) and are automatically retrieved by the user's terminal and displayed on the display screen. Some examples of PRI are cast members' biographies, trivia about the show, information relating to the particular episode or scene, and closeups of information that cannot be readily seen or is hidden in the video portion of the program. Some of the PRI may be time dependent on the program. For example, the PRI may change to correspond to a particular scene or frame of

the television program.

With so much information on the screen, some of which may be changing at a fairly rapid pace, it is desirable to provide the viewer the option of pausing a particular frame of a text-enhanced program display and then resume viewing the program without losing continuity of the video and PRI portions of the program or program content.

According to one embodiment of the invention, a television system is provided which allows a viewer of a PRI-enhanced television program to pause the program at a particular frame, examine the PRI at his or her leisure, perhaps browse through other, linked Web pages, and then resume viewing the program from that frame, without losing continuity of the video and PRI portions of the program or program content.

SUMMARY

According to one embodiment of the invention, an apparatus for time-shifting video and program related information (PRI) in an enhanced television program is provided which includes a display screen, a tuner for receiving a television signal with embedded data representative of an address for an Internet site including PRI, means for extracting the embedded data from the television signal, a memory for storing the embedded data, input means for inputting viewer commands, a time-shifting apparatus capable of simultaneously storing the television signal as it is received and outputting the stored television signal for display, means for communicating with an Internet service provider to retrieve information from the Internet site including the PRI, and a microcontroller. The microcontroller is configured to retrieve the Internet site address from memory and retrieve the PRI from the Internet site in response to a first viewer command, generate a composite display including a television program contained in the television signal in a first portion of the display and the PRI in a second portion of the display in response to the first viewer command, control the time-shifting apparatus to store the television signal as it is received and display a still frame from the stored television signal in a first portion of the display screen in response to a

second viewer command, and control the time-shifting apparatus to output the portion of the stored television signal subsequent to the still frame for display in the first portion of the display in response to a third viewer command.

According to another embodiment, a method for time-shifting video and program related information (PRI) in an enhanced television program is provided which includes the steps of receiving a television signal with embedded data representative of an address for an Internet site including PRI, extracting the embedded data from the television signal, storing the embedded data in a memory, selecting an Internet mode in response to a first viewer command, communicating with an Internet service provider to retrieve information from the Internet site including the PRI, displaying a television program contained in the television signal in a first portion of a display screen and the PRI in a second portion of the display screen, storing the television signal in a time-shifting apparatus and continuously displaying a still frame from the stored television signal in response to a second viewer command, and simultaneously displaying the television program subsequent to the still frame from the stored television signal and continuing to store the television signal as it is received in response to a third viewer command.

According to an alternate embodiment, one or more suspend flags are embedded in the television signal, and the "pause" operation wherein the television signal is stored in the time-shifting apparatus and the still frame displayed in response to detection of such a suspend flag. This feature may be deactivated such that the "pause" operation is only performed in response to a viewer command.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing features and advantages of the invention will be better understood by referring to the following drawings:

FIG. 1 is a schematic block diagram of a time-shifting apparatus according to one embodiment of the invention;

FIG. 2 is a display screen in an Internet mode of the time-shifting apparatus;

FIG. 3 is a display screen accessed by the viewer from the display screen of FIG. 2; and

FIG. 4 is an alternate layout of the display screens of FIGS. 2 and 3.

DETAILED DESCRIPTION

In FIG. 1. the reference numerals refer to the same elements described in application Serial No. 08/475,395 filed on June 6, 1995, the disclosure of which is incorporated fully herein by reference. In addition, the system includes 1) an Internet service provider 33 connected to microprocessor 24 by a transmission link 34 such as a telephone network or a television cable. 2) a VBI decoder 35, 3) a website data memory 36 (memory 36 could be part of the RAM of microprocessor 24 or in terms of the disclosure of the '395 application, memory 22), and 4)a digital Storage Device 52 with associate analog-to-digital and digital-to-analog converters 50, 54. An interface device such as a telephone or cable modem (not shown) couples transmission link 34 to microprocessor 24, if necessary. Internet service provider 33 is connected to an Internet backbone in well known fashion to access data at any site on the WWW.

Storage device 52 is a television signal time-shifting apparatus. One such time-shifting apparatus is disclosed in U.S. patent application Serial No. 08/388,345 to Russo, et al. filed February 14. 1995, which is fully incorporated herein. Such a time-shifting apparatus includes an optical disc for storage of video programs and separate READ and WRITE heads which operate simultaneously such that real time program information can be stored on the disc while previously stored information on the disc can be read and output to the television signal for display. Other storage media which are capable of rapidly storing extremely large amounts of information may also be used, including magnetic tape, optical disk, magneto-optical disk, or solid state memory (i.e., a high capacity charge coupled device), video RAM, etc.

The Storage Device 52 holds a large video data buffer (not shown) for storing the television program in digital form. Preferably, the Storage Device is a random access storage medium allowing concurrent reading and writing operations, so that the incoming television signal data may be written to the Storage Device while earlier stored television signal data is being read out for display on TV 20 (that is, time-shifting of the television signal data is performed). The Storage Device 52 has two heads that are separately positionable. When display of the television program is to be suspended, the read head is kept in the same position until a resume command is received. The write head, however, keeps moving to record the incoming television signal data.

To enable a television viewer to access information about a television program that the viewer is watching, PRI is embedded in the VBI of the television signal carrying the television program. For example, the PRI may be textual information regarding actors and actresses in the show, advertisements of program-related merchandise, brief descriptions of the plot of future episodes of the television program, or any other text regarding the television program, or the PRI may be text representing web pages containing such information.

According to a preferred embodiment, the PRI is contained on a web page, the address for which is embedded in the VBI of the television signal. When the television signal carrying the program being watched is captured by tuner 11, the website data embedded in its VBI is stripped out by VBI decoder 35 and sent to microprocessor 24 for storage in website data memory 36. The memory addresses of the website names are linked to the website addresses in memory 36. An icon appears on the screen of television 20 when the television program is displayed full screen, i.e., in the TV mode, to inform the viewer that website data accompanies the television signal and is stored in memory 22. If the viewer wishes to access a website in connection with the television program, the viewer presses a button on a viewer input device 28 such as a remote controller, which introduces the Internet mode of operation shown in FIG. 2 and described below. Microprocessor 24 is programmed to carry out this operation. By repeatedly pressing a button on the viewer input device, the viewer can toggle

back and forth between the TV mode and the Internet mode. Although viewer inputs are discussed herein as initiated by buttons on a remote controller, other input devices can also be used. For example, a cursor could be displayed on the television screen which is movable around the screen and a selection can be made (i.e., "clicked") when the cursor is in a desired location of the screen.

In the Internet mode, the video portion of the television program last viewed in the TV mode is displayed in area 42. As an option, a textual description of the program is displayed in an area 44 and information about the television program, i.e., program title, station name, and channel number are displayed in a banner 49 underneath areas 42 and 44. A message is displayed at the top of an area 46 to prompt the viewer to select from a number of website names displayed in area 46 by moving a cursor 48 with arrow keys on the viewer input device. For example, if the television program is a serial television show, for example, "Married With Children," the website names could be information related to the show. After a website name is selected, the viewer presses a button on the viewer input device. As a result, the website address to which the selected website name is linked is retrieved from memory 36 by microprocessor 24 and sent through the telephone or cable interface to Internet service provider 33. (If desired, this function of microprocessor 24 could be carried out by commercial equipment sold under the trademark WEB TV.) The information at the addressed website is downloaded from Internet service provider 33 over link 34 to microprocessor 24 and then displayed on the screen simultaneously with the television program to which the information relates, as illustrated in FIG. 3, after being composed by video processor 30. As illustrated in FIG. 3, the name of the website can be displayed above the text of the information from the website. If the television program is a serial television show, as previously stated, the displayed information could include information about the episode, cast biographies, and trivia related to the show. The viewer then navigates about the website in the manner dictated by the viewer's software to find the desired information.

An alternative layout of the television screen for the present invention is shown in

FIG. 4. In this layout, the television program is displayed in a majority portion 60 of the screen while the PRI is displayed along two border regions 62. The Web page including the PRI can be specifically configured to display the PRI in the border regions and an area designated for the real time image in the PIP. The PIP circuitry 19 is specially configured to a smaller reduction ratio, for example 1.5:1 rather than 3:1 for a standard PIP, in order to produce the larger PIP display.

The screen portion 60 displays a television program consisting of moving images.

Referring back to FIG. 1, when the viewer interacts with the website data or other PRI displayed on the television screen, the viewer's attention is diverted from the television program being shown to the website data. The viewer is then missing what is happening in the television program until the viewer's interaction with the PRI is concluded. To overcome this situation, an additional component. Storage Device 52, described above, is added to the system to "time-shift" the display of the television program. As the television signal is being received by Tuner 11, the signal is forwarded through IF Amp 12 and Picture DET 13 to VCR 17. The VCR sends the signal through an analog to digital converter (A/D) 50 to Storage Device 52. The Storage Device is under the control of the Microprocessor 24 and is capable of storing the incoming television signal in real-time as digital information for future use.

As the television signal is being stored, if a viewer wants to interact with the PRI such as website data or other textual information being displayed on the television screen, the viewer sends a command to the microprocessor 24 via the viewer input device 28. The viewer action to send the command could, for example, consist of pushing a button on the viewer input device. In response, the microprocessor 24 controls VCR 17 to output the television signal to the Storage Device 52 which begins storing the television signal, including the PRI information embedded in the VBI. The Storage Device 52 simultaneously outputs the first stored frame of the video signal to the signal processing unit for extended display on television 32. The television 32 continues to display this frame until controlled by

the viewer to continue without effect on any viewer activity with the PRI shown in the remainder of the display screen. The viewer then interacts with the PRI as described above.

When the viewer is done interacting with the PRI, the viewer sends a command to the microprocessor 24 to resume display of the television program. However, instead of displaying the incoming television signal from Tuner 11, the VCR directs the delivery of the stored television signal data output from the READ head of Storage Device 52 through Digital-to-Analog Converter (D/A) 54 and SW 18 to PIP 19 for display on TV 20. The data displayed is that part of the television program immediately subsequent to the point of suspension. That is, it has been time-shifted. The incoming television signal data continues to be stored by the WRITE head of the Storage Device 52 in a time-ordered manner regardless of the functioning of the READ head. In other words, when display of the television program is to be suspended, the READ head is kept in the same position until a resume command is received. The WRITE head, however, keeps moving to record the incoming television signal data. Hence, at this time the data being stored is not the same data that is being displayed; there is a time lag between the two sets of data. In this manner, the viewer may continue watching the program without losing continuity of the program or PRI content. The viewer can position a cursor and enter input to freeze the display of the television program image on command.

In another embodiment, the PRI is contained on several web pages, each corresponding to a particular portion of the program and transmitted chronologically throughout the duration of the program. The television signal including the embedded website addresses is stored on the Storage Device 52 and hence the corresponding Web pages remain linked to the appropriate portion of the television program as the signal is read out from the Storage Device 52 after a "pause" operation. In this manner, the viewer may continue watching the program without losing continuity of the program or PRI content.

The audio portion of the television signal is also stored in the Storage Device along with the video portion. When the live television program is put into a "freeze" frame state,

the audio portion of the television program is also suspended and not transmitted to the viewer. Instead, the audio portion is stored. When display of the suspended television program is resumed, the audio data is obtained from the Storage Device along with the video portion and forwarded by VCR 17 through Sound Amp 15 and loudspeaker 16 to the viewer.

In another embodiment, the television signal is already in digital form, such as for high-definition digital television (HDTV). Therefore, an analog to digital conversion is unnecessary. The Storage Device continuously stores the television signal in a wraparound fashion whenever the system is operational, overwriting the oldest previously stored television signal data when the Storage Device becomes full. The Storage Device should be large enough to hold two to three hours of television programming before overwriting earlier broadcast television signal data.

The present invention allows a viewer to interrupt his or her viewing of a television program to interact with PRI carried in the VBI of the television signal and displayed on the television screen, and yet rejoin the television program at a later point in time without missing any of the program.

In another embodiment, the display of the incoming television signal may be suspended automatically by inserting a suspend flag into the VBI, rather than by an explicit action by the viewer. When the suspend flag is detected by the microprocessor 24 after decoding by VBI decoder 35, the microprocessor instructs the VCR via a control link (not shown) to suspend the current display of the television signal. Resumption of display of the television program is commenced by viewer input. The viewer could also override the automatic suspension feature provided by the suspend flag by setting a predetermined control value to override all automatic suspend flags, or by entering viewer input when the suspension activity occurs in order to rapidly rejoin the television program in progress. Alternatively, a resume flag is inserted into the VBI at a predetermined time after the suspend flag. When the resume flag is received, the microprocessor automatically controls the VCR to resume display of the television program.

According to yet another embodiment, the viewer may access the information as any other storage media, such as a video tape, and pause, rewind, or fast forward to different portions of the program stored on the disc after the initially "pause" command. It may be desirable to continuously record the program on the time-shifting apparatus 46 regardless of a viewer "pause" command to allow for these functions over a period of time, limited only by the storage capacity of the time-shifting device.

Although the present invention has been described with respect to particular embodiments, those skilled in the art will appreciate that the present invention may be modified without departing from the scope of the invention. Accordingly, all such modifications are intended to be included within the scope of the invention as defined by the following claims.

CLAIMS:

1. Apparatus for time-shifting video and program related information (PRI) in an enhanced television program comprising:

a display screen;

a tuner for receiving a television signal with embedded data representative of an address for an Internet site including PRI;

means for extracting the embedded data from the television signal;

a memory for storing the embedded data;

input means for inputting viewer commands;

a time-shifting apparatus capable of simultaneously storing the television signal as it is received and outputting the stored television signal for display;

means for communicating with an internet service provider to retrieve information from the internet site including the PRI; and

a microcontroller comprising

means for retrieving the internet site address from memory and retrieving the PRI from the internet site in response to a first viewer command;

means for generating a composite display including a television program contained in the television signal in a first portion of the display and the PRI in a second portion of the display in response to the first viewer command,

means for controlling the time-shifting apparatus to store the television signal as it is received and display a still frame from the stored television signal in a first portion of the display screen in response to a second viewer command, and

means for controlling the time-shifting apparatus to output the portion of the stored television signal subsequent to the still frame for display in the first portion of the display in response to a third viewer command.

2. The apparatus of claim 1 wherein the time-shifting apparatus is an optical disc.

3. The apparatus of claim 1 wherein the time-shifting apparatus is a solid state memory.

4. The apparatus of claim 1 wherein the PRI comprises text and graphics related to the television program.

5. The apparatus of claim 4 wherein the PRI comprises a plurality of website addresses.

6. The apparatus of claim 5 wherein the microcontroller comprises means for retrieving information from one of said plurality of website addresses in response to a fourth viewer command.

7. The apparatus of claim 1 wherein the first portion of the display covers a minor portion of the display screen and the second portion of the display covers a major portion of the display screen.

8. The apparatus of claim 1 wherein the first portion of the display covers a major portion of the display screen and the second portion of the display covers a minor portion of the display screen.

9. The apparatus of claim 1 wherein the means for communicating with the internet service provider is a modem.

10. A method for time-shifting video and program related information (PRI) in an enhanced television program comprising the steps of:

receiving a television signal with embedded data representative of an address for an internet side including PRI;

extracting the embedded data from the television signal;

storing the embedded data in a memory;

selecting an internet mode in response to a first viewer command;

communicating with an internet service provider to retrieve information from the internet site including the PRI;

displaying a television program contained in the television signal in a first portion of a display screen and the PRI in a second portion of the display screen;

storing the television signal in a time-shifting apparatus and continuously displaying a still frame from the stored television signal in response to a second viewer command; and

simultaneously displaying the television program subsequent to the still frame from the stored television signal and continuing to store the television signal as it is received in response to a third viewer command.

11. The method of claim 10 wherein the PRI comprises a plurality of website addresses and further comprising the steps of:

selecting one of the plurality of website addresses in the PRI;

retrieving information from the selected website address; and

displaying the information from the selected website address.

12. A method for time-shifting video and program related information (PRI) in an enhanced television program comprising the steps of:

receiving a television signal with embedded data representative of an address for an internet side including PRI and a suspend flag;

extracting the embedded data from the television signal;

storing the embedded data in a memory;

selecting an internet mode in response to a first viewer command;

communicating with an internet service provider to retrieve information from the internet site including the PRI;

displaying a television program contained in the television signal in a first portion of a display screen and the PRI in a second portion of the display screen;

detecting the suspend flag;

storing the television signal in a time-shifting apparatus and continuously displaying a still frame from the stored television signal; and

simultaneously displaying the television program subsequent to the still frame from the stored television signal and continuing to store the television signal as it is received in response to a second viewer command.

13. The method of claim 12 wherein the step of storing ten television signal in the time-shifting apparatus is performed in response to detecting the suspend flag.

14. The method of claim 12 wherein the step of storing the television signal in the time-shifting apparatus is performed in response to a third viewer command.

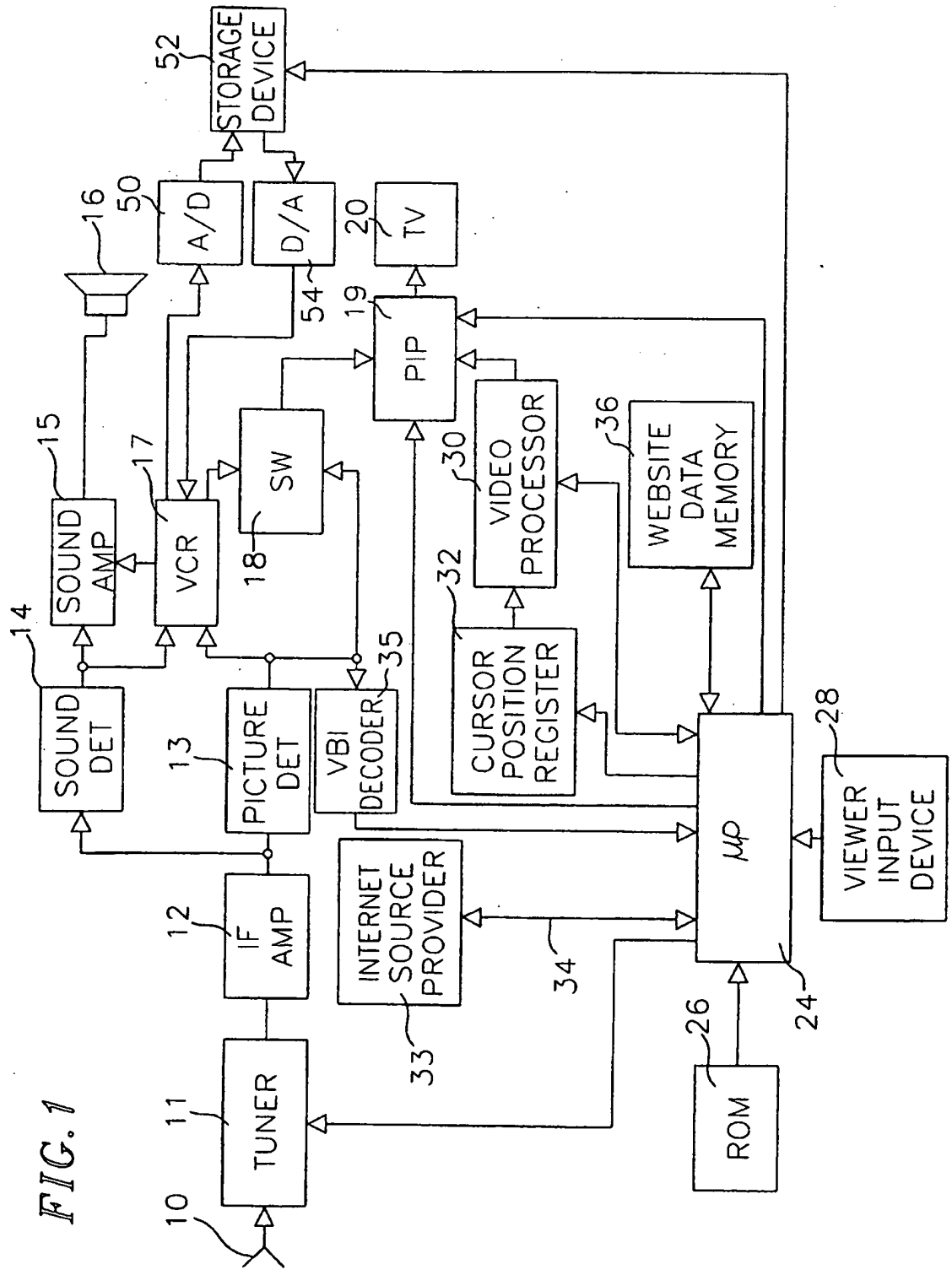

STORAGE DEVICE
52
A/D
50
D/A
TV
20
16
54
19
PIP
SOUND AMP
15
VCR
17
SW
18
VIDEO PROCESSOR
30
WEBSITE DATA MEMORY
36
SOUND DET
14
PICTURE DET
13
VBI DECODER
35
CURSOR POSITION REGISTER
32
μp
28
VIEWER INPUT DEVICE
IF AMP
12
INTERNET SOURCE PROVIDER
33
34
TUNER
11
10
ROM
26
24

FIG. 1

FIG. 2

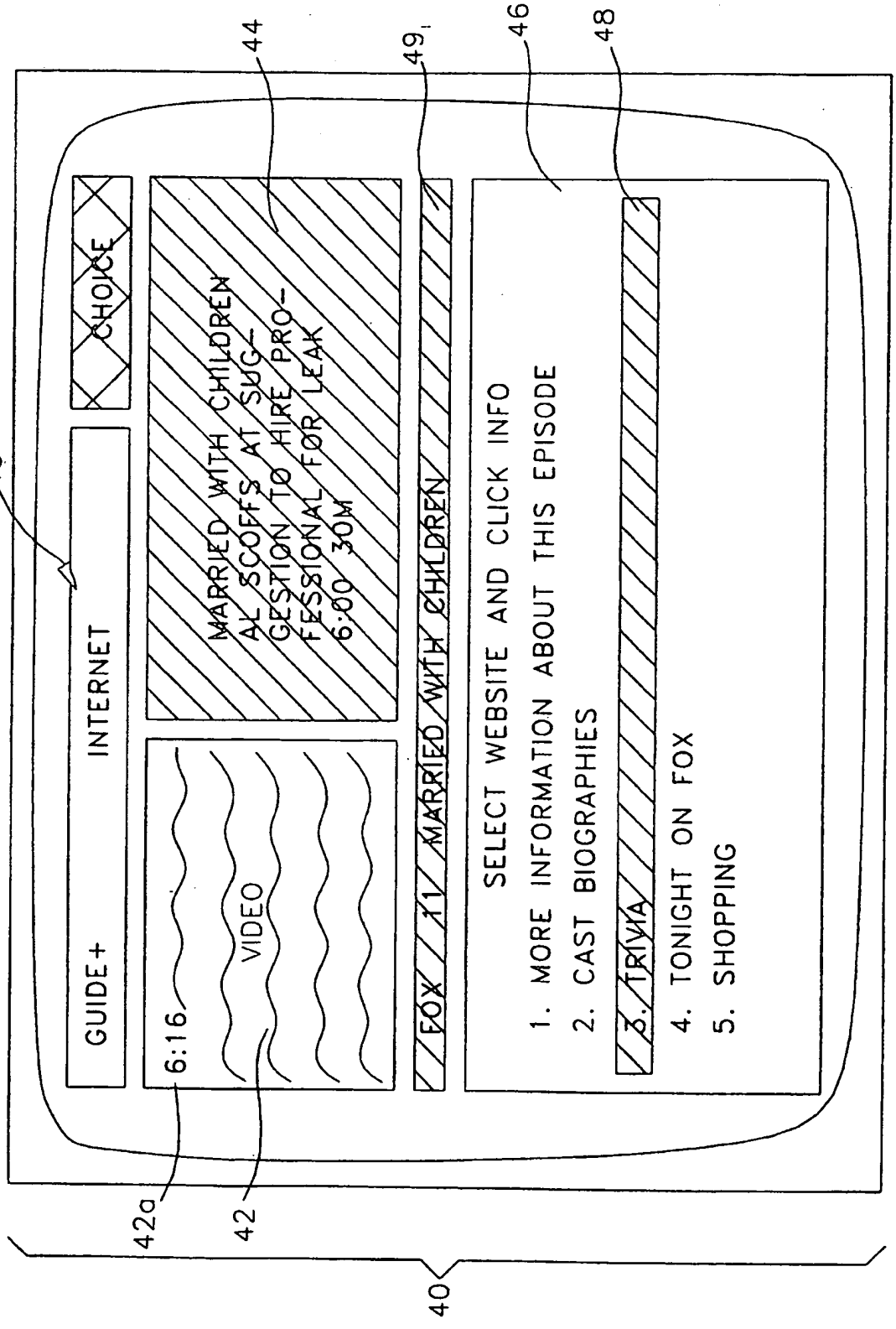

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46
48
CHOICE
INTERNET
GUIDE+
MARRIED WITH CHILDREN
AL SCOFFS AT SUG-
GESTION TO HIRE PRO-
FESSIONAL FOR LEAK
6:00 30M
6:16
VIDEO
FOX 11 MARRIED WITH CHILDREN
SELECT WEBSITE AND CLICK INFO
1. MORE INFORMATION ABOUT THIS EPISODE
2. CAST BIOGRAPHIES
3. TRIVIA
4. TONIGHT ON FOX
5. SHOPPING
42a
42
40

FIG. 3

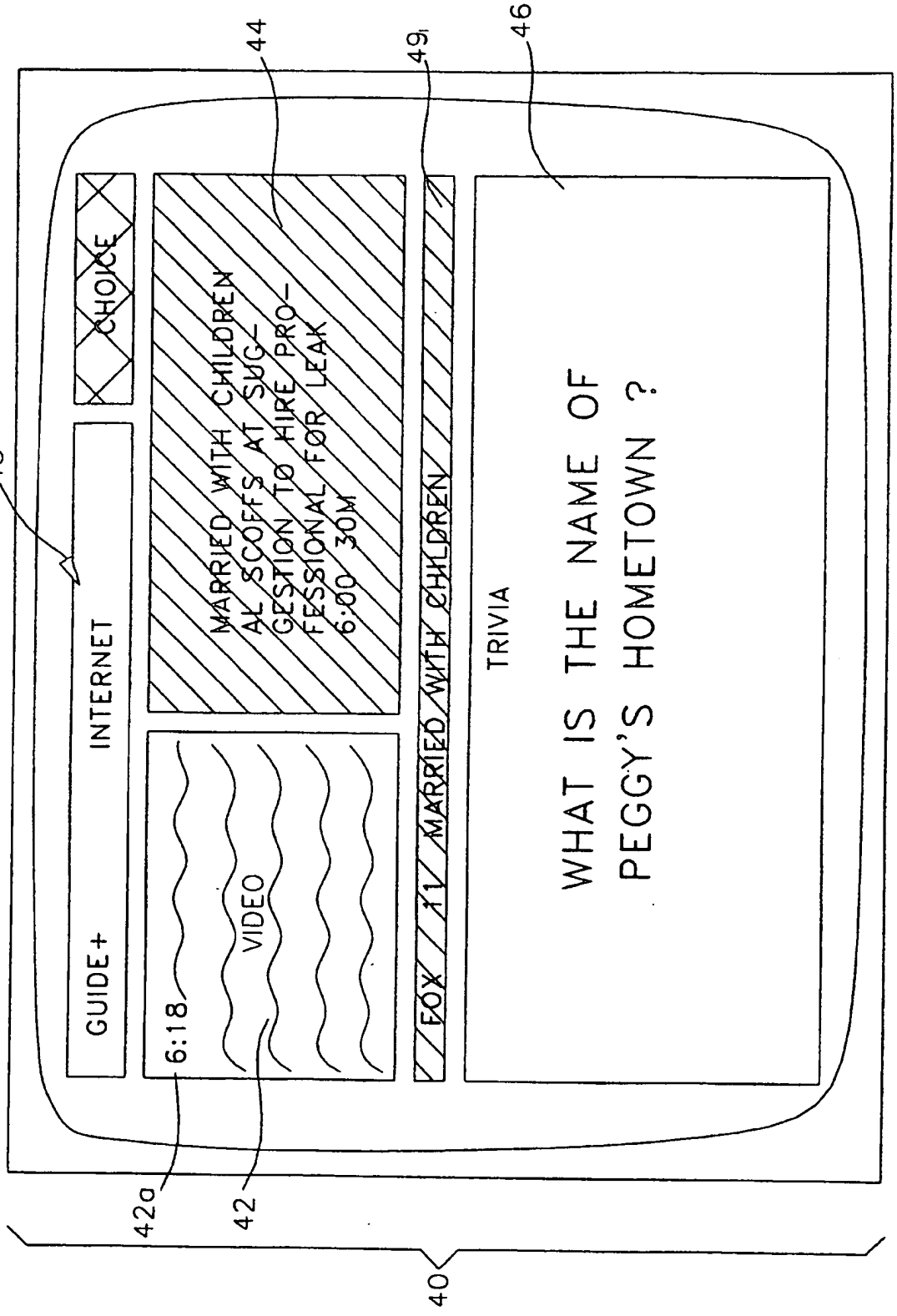
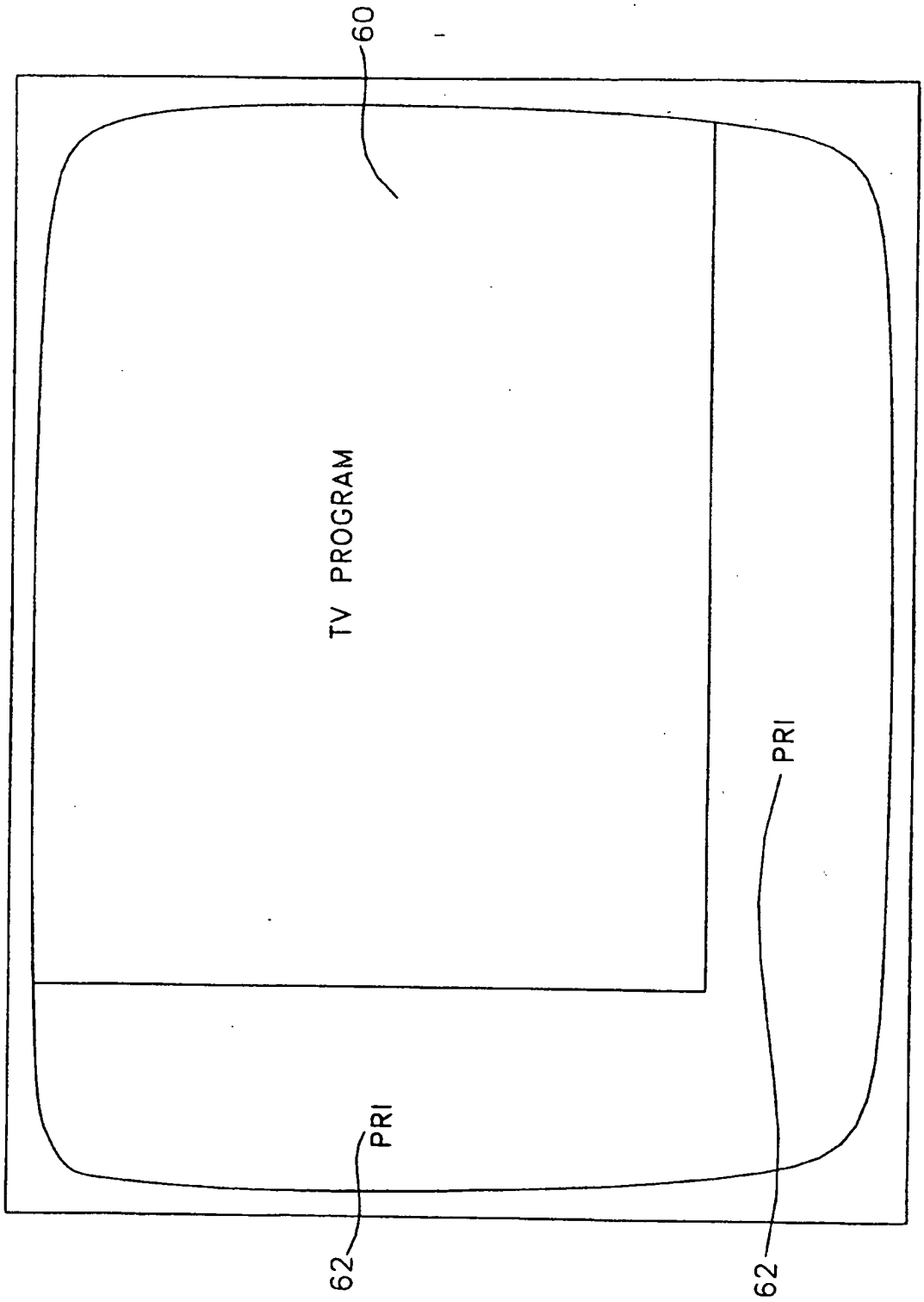

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CHOICE
INTERNET
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MARRIED WITH CHILDREN
AL SCOFFS AT SUG-
GESTION TO HIRE PRO-
FESSIONAL FOR LEAK
6:00 30M
TRIVIA
WHAT IS THE NAME OF
PEGGY'S HOMETOWN ?
6:18
VIDEO
FOX 11 MARRIED WITH CHILDREN
42a
42
40

FIG. 4



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(71) Applicant: COACTIVE NETWORKS, INC. [US/US]; Suite 303, 4000 Bridgeway, Sausalito, CA 94965 (US).

(72) Inventors: GAW, David; 200A San Rafael Avenue, San Rafael, CA 94901 (US). KOCH, Ed; 218 Devon Drive, San Rafael, CA 94902 (US). MARSH, Adam; 40 Stewer, San Francisco, CA 94117 (US). HENNAGE, Dan; 915 Centro Way, Mill Valley, CA 94941 (US).

(74) Agents: SAWYER, Joseph, A., Jr. et al.; Sawyer & Associates, P.O. Box 51418, Palo Alto, CA 94303 (US).

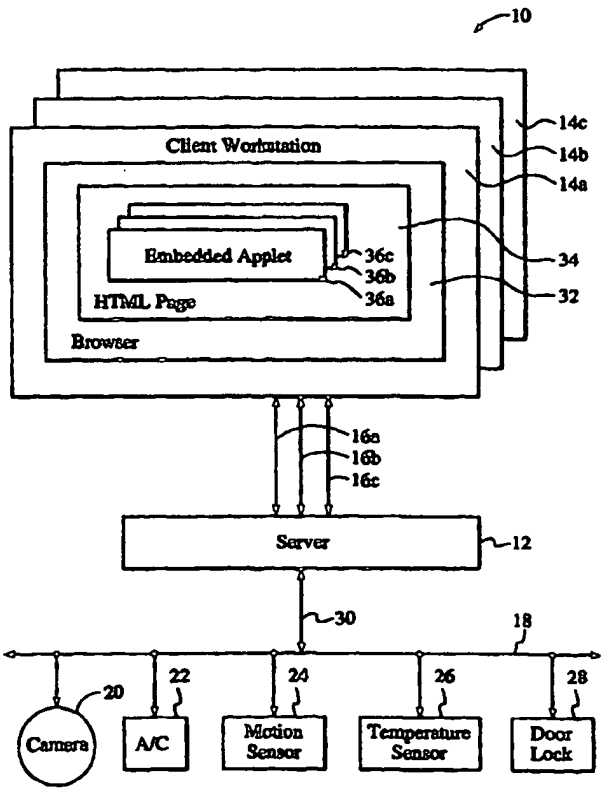
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(54) Title: SERVER SYSTEM AND METHOD FOR NETWORKING CONTROL NETWORKS AND DIRECT INPUT/OUTPUT DEVICES WITH THE WORLD WIDE WEB

(57) Abstract

A scalable control data networking system which has an open ended architecture and which is platform and protocol independent. The server of this system accesses control data via a web browser over a network which receives data from a control network or direct I/O sources, translates the data to and from a generic control protocol, and manages communication of the generic control protocol with multiple clients. The server acts as a physical and network interface to the control network or direct I/O sources and translates the native control data or direct I/O data to and from a genericcontrol protocol format. The server also performs the function of managing communication with a plurality of clients using open standards such as the TCP/IP protocol. One or more embedded applets graphically display the control data and permit the user to monitor and regulate the control data.



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SERVER SYSTEM AND METHOD FOR NETWORKING CONTROL NETWORKS AND DIRECT INPUT/OUTPUT DEVICES WITH THE WORLD WIDE WEB

BACKGROUND OF THE INVENTION

This invention pertains generally to data communications, data processing and information retrieval in networked computer systems. More specifically, the present invention is a server system for accessing control data via web browsers over a network which receives data from a control network or direct I/O sources, translates the data to and from a generic control protocol, and manages communication of the generic control protocol with multiple clients.

Vertically integrated, proprietary control data networking systems such as SCADA (Supervisory Control and Data Acquisition) systems are widely used in industry for numerous operations or procedures, including building security, temperature control, and control of pressure or fluid levels in reactors and reservoirs. Figure 4 is a functional block diagram of a conventional vertically integrated control data networking system 400. This system 400 comprises a plurality of client work stations 14a, 14b, 14c associated with a control network 18 by a network connection 420. The control network has a plurality of devices shown generally as camera 20, air conditioner 22, motion sensor 24, temperature sensor 26 and door lock 28. A variety of device types may be associated with the control network 18. The workstations 14a, 14b, 14c communicate with the control network 18 through an application 440 on the workstations which is specifically written for interfacing with the control network 18. These vertically integrated control data networking systems are generally based on proprietary technologies and are not designed with open-ended architectures, and often are site-specific and device-specific. Thus, the systems lack scalability, are highly platform dependent, and are limited to specialized network architectures and protocols. As a result, these systems are not adaptable to rapidly changing computer networking technologies, and the selection of software and hardware which can be used with the systems is severely limited.

Control networks such as LONWORKS™ and DEVICENET™ have more recently been employed in control data networking systems. These control networks are

somewhat more flexible than vertically integrated proprietary control data networking systems because LONWORKS™ and DEVICENET™ have established standards that reduce protocol conflicts and permit limited open-ended architecture. However, in order to implement these control networks a substantial investment in networking infrastructure, such as transmission media, routers and gateways is required. Further, existing control networks still lack scalability, are generally platform dependent, and are not readily adaptable to different protocols. Thus, it is currently difficult to link control network subsystems into larger networks, connect control systems into wide area networks, implement supervisory control from one network to another, or provide generally for information flow between lower-level systems and higher level information networks.

In both information and control networks generally, it is more cost-effective to leverage existing standards and technologies. Accordingly, there is a need for a scaleable control data networking system which has open ended architecture and which is platform and protocol independent. The present invention satisfies these needs, as well as others, and generally overcomes the deficiencies found in existing control data networking systems.

SUMMARY OF THE INVENTION

The present invention is a server system and method for networking control networks and direct input and output from devices to allow accessing of control data via the World Wide Web. In its most general terms, the system of the invention comprises a server and a plurality of embedded client applets. The server includes programming which carries out the operations of receiving control data from one or more direct I/O sources and/or control networks, translating the received control data into a generic control protocol, and managing communication of the generic control protocol between the server and a plurality of clients. The plurality of client applets, which are embedded in a corresponding plurality of Web pages, communicate control data to the server using the generic control protocol, and present control data to client users in the form of graphical displays on the Web pages.

The "World Wide Web" or "Web" is a client-server hypertext information and communication system popularly used on the Internet and intranet computer networks.

The "Internet" is a cooperatively run, globally distributed collection of computer networks which exchange information through the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite. "Hypertext" is text which is not constrained to a single linear sequence. The Web and Internet have made possible the sharing of information between computers all over the world through use of Web "browser" programs such as NETSCAPE NAVIGATOR™ and MICROSOFT EXPLORER™, which allow users to access the Web. An important feature of hypertext documents is that they can contain special embedded "links" that enable users to connect with other related hypertext documents. Hypertext Transfer Protocol (HTTP) is the native protocol of the Web, and is used to transfer hypertext documents between computers networked through the Internet and Web. Hypertext documents are generally in the form of Hypertext Media Language (HTML) pages or Web pages.

The development of the World Wide Web has been facilitated by the development of object oriented programming (OOP) languages for computers. OOP is a relatively new programming paradigm which allows computer programs to be broken down into component parts. Commonly used OOP languages include C++, JAVA and Smalltalk. OOP provides an implementation method wherein computer programs are organized as cooperative collections of software objects, each of which represents an instance of some class, with the classes being members or a hierarchy of classes united by inheritance relationships. Software objects generally comprise data fields in the form of instance variables that are encapsulated by one or more methods. Interconnected objects within a program communicate via messages. The encapsulated nature of OOP allows OOP applications existing on a Web server to be downloaded to Web clients having varying types of machines and operating systems. The OOP JAVA is designed to be machine independent and function within different operating systems. JAVA permits scaled-down applications called "applets" which can be incorporated into Web sites and run off of individual HTML pages. JAVA applets require a JAVA-enabled browser such as the widely used NETSCAPE NAVIGATOR™ and MICROSOFT EXPLORER™ browsers.

Internet working systems are typically built around a set of discrete systems which may be highly integrated, yet operate as functionally separate parts. The

encapsulated nature of OOP lends itself well to network and communication systems in that data from one protocol can be encapsulated within methods of another protocol. The encapsulating protocols must be open ended to allow data to be translated between different protocols.

Many low level devices such as air conditioners, motion sensors, temperature sensors, cameras, and door locks have recently evolved to incorporate intelligence through increasingly inexpensive microprocessors which are embedded into the devices. This trend has created the potential for remotely accessing information associated with these devices, such as temperature, real time images, and device status. The present invention utilizes the World Wide Web and advantages of OOP to access such data via direct I/O of remote devices or from control networks associated with an array of devices, and to provide the data to Web clients independent of particular platforms, protocols or network architectures.

By way of example, and not of limitation, the server of the invention is embodied in a conventional programmed data processor such as a PC containing encoded executable instructions for carrying out program operations in accordance with the invention. The server includes a plurality of interfaces, with an information network interface such as an ETHERNET TCP/IP interface, a control network interface which may be based on LONWORKS ™or DEVICENET™ standards, and a direct I/O interface. The web client programs are embodied in machines or workstations such as PC, APPLE MACINTOSH™, UNIX™, or like programmed data processors which can support client or web browser programs such as NETSCAPE NAVIGATOR™ and MICROSOFT EXPLORER™ as well as a plurality of HTML pages.

By way of example, and not of limitation, a single static JAVA client object is included per each of the plurality of HTML page. One or more separate input and output JAVA applets on the HTML page provide graphical user interface (GUI) applet devices or widgets which access the static JAVA client object for accessing control data. The server is networked to the static JAVA client applets via conventional TCP/IP sockets. Other alternative networking means may be used as alternatives to TCP/IP sockets, including distributed object method invocations, such as CORBA calls managed by an external Object Request Broker or OLE. Since the GUI applets are JAVA based and run off the HTML pages rather than being server-pushed, the applets provide for real time

client user interaction.

The programming associated with the server includes conventional software applications for providing information and/or services to client programs according to client program requests. The server of the invention also comprises programming means for carrying out the operations of:

(a) managing communications with a plurality of clients;

(b) performing control data translations or exchanges between a generic control protocol and native control data formats; and

(c) interfacing to control networks and/or direct I/O.

(d) intelligent management of control data including data aggregation, event monitoring, and data logging.

In performing control data translations between the generic control protocol and native control data formats, the programming preferably also provides means for carrying out the operations of identifying I/O points, identifying data points, and data formatting. The translating operates in both directions, and the server architecture and programming handles control data requests and assignments from the GUI applets and control data updates and results from the control network and/or direct I/O points.

The server system of the invention preferably incorporates both polling and event driven methods of control data exchange. The generic control protocol of the invention preferably comprises:

(a) means for providing node identification;

(b) means for providing I/O point identification;

(c) means for providing data types;

(d) means for providing data units; and

(e) means for providing data values.

In using the invention, a user at a client workstation runs the web browser program and establishes a network connection with the server via modem and dial-up serial connection or other standard manner. The user identifies the location or address for the desired HTML page(s) corresponding to the particular control data which the user wants to access by URL (Uniform Resource Locator) address or other standard means. The embedded applets on the selected HTML page(s) graphically display the control data from the remote devices and provide selectable options to the user, such as setting or

parameter changes for the remote devices. The user can select particular desired control data by "clicking" on the appropriate applet using a mouse, tracking ball or other conventional means. After viewing the selected control data, the user can change a setting or control on the remote device by clicking on the appropriate applet.

An object of the invention is to provide a server system and method for networking control networks and direct input and output which allows remote accessing of control data via the World Wide Web.

Another object of the invention is to provide a server system and method for networking control networks and direct input and output which has an open-ended architecture and is scalable.

Another object of the invention is to provide a server system and method for networking control networks and direct input and output which is platform and protocol independent.

Another object of the invention is to provide a server system and method for networking control networks and direct input and output which utilizes embedded applets networked to a server for communicating control data.

Another object of the invention is to provide a server system and method for networking control networks and direct input and output which translates native control data formats to a generic control protocol which accommodates data and I/O point identification schemes of multiple different control network protocols without losing information from any protocols.

Another object of the invention is to provide a server system and method for networking control networks and direct input and output which manages communication of control data with multiple clients.

Another object of the invention is to provide a server system and method for networking control networks and direct input and output which allows the linking of control network subsystems into large networks.

Another object of the invention is to provide a server system and method for networking control networks and direct input and output which allows information flow from low level systems to higher level systems.

Further objects and advantages of the invention will be brought out in the following portions of the specification, wherein the detailed description is for the purpose

of fully disclosing preferred embodiments of the invention without placing limitations thereon.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood by reference to the following drawings, which are for illustrative purposes.

FIG. 1 is a functional block diagram of a server system for networking control networks and direct input and output in accordance with the present invention which illustrates generally the architectural components of the invention.

FIG. 2 is a functional block diagram of a server system for networking control networks and direct input and output in accordance with the present invention which illustrates the logical operation of the invention.

FIG. 3 is a functional block diagram of a server system for networking control networks and direct input and output in accordance with the present invention which illustrates a specific preferred implementation architecture for the invention.

FIG. 4 is a functional block diagram of a conventional vertically integrated networking system.

FIG. 5 is a flow chart diagram of the translation of messages from the GCP to control data format in accordance with the present invention.

FIG. 6 is a flow chart diagram of the translation of messages from the control data format to the general control protocol in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring more specifically to the drawings, for illustrative purposes the present invention is embodied in the server system generally shown in FIG. 1 through FIG. 3. It will be appreciated that the server system may vary as to configuration and as to details of the components and architecture, and that the method may vary as to details and the order of the steps without departing from the basic concepts as disclosed herein.

Referring now to FIG. 1, a server system 10 in accordance with the invention is generally shown. System 10 includes a server 12 and a plurality of client work stations 14a, 14b, 14c associated with server 12 by a corresponding plurality of wide area network connections 16a, 16b, 16c. Server 12 is also networked with a control network

18 having a plurality of devices shown generally as camera 20, air conditioner 22, motion sensor 24, temperature sensor 26 and door lock 28. The particular nature of devices 20-28 is exemplary, and a variety of device types which perform monitoring and/or control functions may be associated with control network 18. Network connection 30 links server 12 with control network 18. Network connection 30 could alternatively link with an array of direct I/O from separate devices instead of, or in addition to control network 18.

Server 12 is preferably a conventional programmed data processor or computer having logic circuits implemented in hardware and/or software which perform various operations, described more fully below, according to computer programming based on executable instructions encoded in a computer memory of server 12. Work stations 14a-c likewise are preferably conventional programmed data processors having logic circuits implemented in hardware and/or software which support standard client applications operating with standard commercial platforms or operating systems such as WINDOWS™ MACINTOSH™, UNIX™, or the like. Control network 18 is a local area network (LAN) based on LONWORKS™, DEVICENET™ or like control network standards.

The devices 20-28 associated with control network 18 are "smart" and include a microprocessor or computer (not shown) embedded in or otherwise associated with each device 20-28. The embedded microprocessors include conventional means for monitoring and communicating status and other control data of devices 20-28 to control network 18. Devices 20-28 are linked within control network 18 by standard means. Network connections 16a-c and 30 are standard connections which, at the physical layer, preferably comprise modems and dial-up serial connections.

Client workstations 14a-c each support a browser program 32 such as NETSCAPE NAVIGATOR™, MICROSOFT EXPLORER™ or like client application. Each work station 14a-c may support multiple browsers 32, although only one is shown for reasons of clarity. Each browser 32 supports a plurality of HTML pages 34, of which only one is shown for clarity. Each HTML page 34 in turn supports a plurality of embedded applets 36a-c. As noted above, applets 36a-c are preferably JAVA GUI applets which graphically provide user interfaces for displaying data and allowing client users to change settings or parameters of devices 20-28 from remote locations via the

Web.

Embedded applets 36a-c and HTML page 34 are platform independent, and any browser 32 (which can support applets) as well as any type of client workstation 14a-c may be used with system 10. Likewise, the nature and configuration of control network 18 may be varied depending upon particular situations wherein system 10 is employed. Thus, multiple applets 36a-c on each HTML page 32, multiple HTML pages 34 on each web browser 32, multiple web browsers 32 on each workstation 14a-c, and multiple workstations 14a-c all communicate with a single server 12 over a network. Server 12 manages the client applets 36a-c on one side of system 10, and communicates with control network 18 on the other side of system 10.

The server 12 in accordance with the present invention translates the data from the workstations 14a-c from the platform independent form to a platform dependent form which the control network 18 can understand. Likewise, the server 12 translates the data from the control network 18 from a platform dependent form to a platform independent form which is understood by the workstations 14a-c.

The logical operation of the invention will be more fully understood by reference to FIG. 2 as well as FIG. 1, wherein the logical architecture 33 of the system 10 of the invention is shown. Generally, multiple applets 36a-c run on each HTML page 34a-c, as described above. HTML version 3.2 supports applet tags which allow applets 36a-c to run when HTML pages 34a-c are loaded to a web browser(s). The applet tags also allow applets 36a-c to draw to a particular desired section of the screen area of HTML page 34a-c.

Each applet 36a-c generally performs two functions: the display of control data in graphical form to users, and communication of control data with server. The display of control data to users, shown as Control Data Display program operation 38, is preferably provided in the form of a graphical user interface or GUI devices (not shown). The GUI devices may be in the form of a gauge, graph, button, dial, meter, slider, text or like conventional GUI devices. Means for transforming control data into various desired formats or units are included with applets 36a-c, and preferably comprise suitable input and output GUI devices such as buttons, text, sliders, dials, lights, gauges, graphs (bar and/or plot) or like icons which suitably positioned on HTML pages 34a-c and which can be selected and actuated by a user via "clicking" on the GUI device with a mouse,

tracking ball or like user interface device.

Each applet 36a-c also includes means for communicating control data with server 12 using a Generic Control Protocol (GCP). The GCP, which is described further below, is non-specific as to forms of control networking or I/O types. The means for sending and receiving or otherwise communicating control data with server 12 in GCP is shown generally as Send/Receive Control Data in GCP program operation 40.

Server 12 is connected to applets 36a-c at the physical level by network connections 16a-c, and to control network 18 or other source of control data by network connection 30. Server 12 includes programming means for carrying out the operations of:

(a) managing communications with a plurality of clients;

(b) performing translations between a Generic Control Protocol and native control data formats of devices 20-28 and/or control network 18; and

(c) interfacing to control networks 18 and/or direct I/Os of non-networked devices.

(d) intelligent management of control data including data aggregation, event monitoring, and data logging.

The communication managing means of server 12, shown as communication management program operation 42, allows communication between server 12 and multiple client workstations 14a-c, and thus multiple applets 36a-c, which may be on the same or different HTML pages 34a-c, browsers 32 or workstations 14a-c, can communicate with server 12 simultaneously.

The translation performing means of server 12, shown as GCP/control data translation program operation 44, performs control data translations between the Generic Control Protocol and native control data formats. The translation performing means also preferably comprises programming means for carrying out the operations of identifying I/O points, identifying data points, and data formatting. The translation performing means operates in both directions (GCP to native control data format and native control data format to GCP), and handles control data requests and assignments from the GUI applets and control data updates and results from the control network and/or direct I/O points.

The translation performing means are illustrated in Figures 5 and 6. Figure 5 is a

flow chart diagram of the translation of messages from the GCP to control data format in accordance with the present invention. The server 12 begins at an idle status, via step 502. When a message arrives from a workstation 14a-14c, via step 504, it is first parsed out into data units which correspond to data units on the control network, via step 506. Then the data units are each translated from the GCP to the control protocol format, via step 508. The translated data units are then transmitted to the control network, setting the corresponding control network data units to the appropriate values, via step 510. From these values, control network messages are initiated, via step 512. The messages prompts the actions which are appropriate for the values of the data units.

Figure 6 is a flow chart diagram of the translation of messages from the control data format to the GCP in accordance with the present invention. Again, the server 12 begins at an idle status, via step 602. When the time comes to send updates for the values of the data units on the control network, via step 604, the server 12 fetches the control network data unit values to be updated, via step 606. Conditions prompting a sending of updates include a request for updates from a client, updates which are periodically sent and updates sent based on a condition, such as the changing of a temperature past a threshold. It packs the data units into a single message via step 608, encodes the message from the control protocol format to the GCP via step 610, and then transmits the message to the proper workstations 14a-14c, via step 612.

The interfacing means of server 12, shown generally as control data interface program operation 46, provides a logical interface with control network 18 or other control data sources such as an array of direct I/O points.

The server architecture 33 comprises primarily server 12 and its program operations, and embedded applets 36a-c and their program operations. The hardware supporting architecture 33 is preferably as generic and interchangeable as possible to allow open-endedness, scalability and adaptability to changing technologies. The architecture 33 permits sufficient flexibility so that at least one applet 36a-c, on at least one HTML page 34a-c, on at least one browser 32, on at least one work station 14a-c can be utilized.

Referring now to FIG. 3, as well as FIG. 1 and FIG. 2, a preferred implementation of the invention is generally shown as architecture 48, wherein like reference numbers denote like components. Preferably, a single static JAVA Client

Object 50 is used per HTML page 34a-c. Applets 36a-c are preferably JAVA GUI applets, each of which makes calls to JAVA Client Object 50 by messages 52a-c. Each JAVA GUI applet 36a-c has an associated GUI device 54, of which only one is shown for clarity.

Generally, the server system of the invention will incorporate both polling and event-driven methods of control data exchange. In the preferred architecture 48, one JAVA Client Object 50 exists per HTML page 34a-c. JAVA Client Objects 50 are static, and each include an init() initialization method called by each JAVA GUI applet 36a-c which creates JAVA Client Object 50 if it not already present. Each JAVA Client Object 50 also includes update() methods that register JAVA GUI applets 36a-c for proper updates, which are preferably polling or event-driven, as related above.

JAVA Client Object 50 manages control data updates with server 12 and manages communications with each of the multiple JAVA GUI applets 36a-c. Each JAVA Client Object 50 sends and receives control data in Generic Control Protocol, shown as Send/Receive Control Data in GCP operation 40. Each JAVA Client Object 50 registers as a client of server 12, accepts registration from multiple JAVA GUI applets 36a-c, and establishes a set of polling or event-driven updates to be routed between JAVA GUI applets 36a-c and server 12. JAVA Client Objects 50 preferably communicate with server 12 via a plurality of TCP/IP sockets 56a-c over corresponding physical layer connections 16a-c (FIG. 1). TCP/IP sockets 56a-c may be modified to utilize distributed object invocation methods such as CORBA (Common Object Request Broker Architecture) calls managed by an external object broker. CORBA provides an open object infrastructure wherein object interfaces are described in IDL (Interface Definition Language). Alternatively, TCP/IP sockets may be modified to utilize OLE (Object Linking and Embedding) standards for distributed objects. However, OLE is currently supported only by MICROSOFT™, and does not provide connectivity between different platforms as does CORBA. Other distributed object standards, such as DCE (Distributed Computing Environment), may alternatively be used in association with TCP/IP sockets, depending upon particular uses of the invention.

JAVA GUI applets 36a-c support methods to display changing control data from devices 20-28 in control network 18 according to client user specifications. JAVA GUI applets 36a-c display control data on HTML pages 34a-c via GUI devices 54. GUI

devices 54 are preferably familiar or common graphical items such as gauges, graphs, buttons, dials, meters, sliders, text or like conventional icons. GUI devices 54 include both input GUI devices and output GUI devices. Parameters that JAVA GUI applets 36 accept as arguments when called from an HTML page 34a-c preferably include:

(a) size of GUI devices 54;

(b) screen position of GUI devices 54;

(c) polling frequency or event threshold value;

(d) control data identifier (control network node or direct I/O point);

(e) specific GUI parameters (labels, colors, options and the like).

When called from an HTML page 34a-c, each JAVA GUI applet 36a-c registers with the JAVA Client Object 50 for that particular HTML page and passes the relevant parameters to the JAVA Client Object 50. These parameters preferably include polling frequencies, event threshold values, and control data identifiers. As the JAVA Client Object 50 updates, JAVA GUI applets show changes in control data via GUI devices 54 on the HTML page 34a-c.

Server 12 preferably comprises an embedded PC with an interface to information network and an interface to control network 18 and/or direct device I/Os. As noted above, network connections 16a-c are preferably ETHERNET using the TCP/IP protocol suite. Server 12 includes programming means for managing communications with a plurality of JAVA Client Objects 50, which is shown generally as communication management operation 42. Server 12 manages JAVA client objects 50, and preferably handles multiple JAVA Client Objects 50 via multiple open TCP/IP sockets 56a-c. Registration and data requests are handled by the JAVA Client Objects 50, and events and data from control network 18 are propagated to all registered JAVA Client Objects 50.

Server 12 also includes programming means for performing translations of control data and control data requests between a Generic Control Protocol and the native control data formats of devices 20-28 and/or control network 18, shown generally as GCP control data translation operation 44. This operation includes I/O point identification, data types, and data formatting. The translating operates in both directions, handling control data requests and assignments from JAVA GUI applets 36a-c, as well as control data updates and results from control network 18 and/or direct I/O

points.

Server 12 also includes programming means for interfacing with control network 18 and/or direct I/Os of non-networked devices. In the case of the preferred architecture 48 shown in FIG. 3 wherein control network 18 is a LONWORKS™ control network.

The Generic Control Protocol of the invention can accommodate data and I/O point identification schemes of various different control network protocols without losing any information from any particular protocol. The Generic Control Protocol preferably includes

(a) means for providing node identification;

(b) means for providing I/O point identification;

(c) means for providing data types;

(d) means for providing data units; and

(e) means for providing data values.

CLAIMS

What is claimed is:

1. A method for providing computer network connectivity, the computer network including a control network and a plurality of workstations coupled to the control network, the control network including a specific control protocol, and the plurality of workstations including a generic control protocol, the method comprising:

(a) communicating control data in the generic control protocol format between the plurality of workstations and the server;

(b) translating control data from the generic control protocol format to the specific control protocol format and from the specific control protocol format to the generic control protocol format; and

(c) communicating control data in the specific control protocol format between the server and the control network.

2. The method of claim 1, wherein the translating step (b) comprises:

(b1) parsing out a plurality of data units in the generic control protocol format;

(b2) translating each of the plurality of parsed out data units from the generic control protocol format to the specific control protocol format;

(b3) setting the values of a plurality of control network data units which correspond to the plurality of parsed out translated data units; and

(b4) means for initiating control network messages according to the values of the plurality of control network data units.

3. The method of claim 1, wherein the translating step (b) comprises:

(b1) fetching the values of a plurality of control network data units in the specific control protocol format;

(b2) packing the plurality of control network data units into a single message; and

(b3) encoding the single message into the generic control protocol

format.

4. The method of claim 1, wherein each of the plurality of workstations comprise:

(a) at least one web browser program;

(b) a plurality of Hypertext Media Language pages supported by the web browser programs; and

(c) a plurality of embedded applets supported by the Hypertext Media Language pages.

5. The method of claim 4, wherein the embedded applets function as the means for communicating control data in the generic control protocol format between the server and the plurality of workstations.

6. The method of claim 1, wherein the translating step (b) further comprises:

(b1) identifying input/output points;

(b2) identifying data points; and

(b3) identifying data formatting.

7. The method of claim 1, wherein the generic control protocol of the translating step (b) comprises:

(a) providing node identification;

(b) providing input/output point identification;

(c) providing data types;

(d) providing data units; and

(e) providing data values.

8. A system for computer network connectivity, the computer network including a control network and a plurality of workstations coupled to the control network, the control network including a specific control protocol, and the plurality of workstations including a generic control protocol, the system comprising:

means for communicating control data in the generic control protocol

format between the server and the plurality of workstations;

means for translating control data from the generic control protocol format to the specific control protocol format and from the specific control protocol format to the generic control protocol format; and

means for communicating control data in the specific control protocol format between the server and the control network.

9. The system of claim 8, wherein the translating means comprises:

means for parsing out a plurality of data units in the generic control protocol format;

means for translating each of the plurality of parsed out data units from the generic control protocol format to the specific control protocol format;

means for setting the values for a plurality of control network data units which correspond to the plurality of parsed out translated data units; and

means for initiating control network messages according to the values of the plurality of control network data units.

10. The system of claim 8, wherein the translating means comprises:

means for fetching the values of a plurality of control network data units in the specific control protocol format;

means for packing the plurality of control network data units into a single message; and

means for encoding the single message into the generic control protocol format.

11. The system of claim 8, wherein each of the plurality of workstations comprise:

(a) at least one web browser program;

(b) a plurality of Hypertext Media Language pages supported by the web browser programs; and

(c) a plurality of embedded applets supported by the Hypertext Media Language pages.

12. The system of claim 11, wherein the embedded applets function as the means for communicating control data in the generic control protocol format between the server and the plurality of workstations.

13. The system of claim 8, wherein the translating means further comprises:
means of identifying input/output points;
means for identifying data points; and
means for identifying data formatting.

14. The system of claim 8, wherein the generic control protocol comprises:
means for providing node identification;
means for providing input/output point identification;
means for providing data types;
means for providing data units; and
means for providing data values.

15. A server for a computer network system, the computer network system including a control network and a plurality of workstations, the control network including a specific control protocol, and the plurality of workstations including a generic control protocol, the server comprising:

(a) means for communicating control data in the generic control protocol format with the plurality of workstations;

(b) means for translating control data in the generic control protocol format to the specific control protocol format and from the specific control protocol format to the generic control protocol format; and

(c) means for communicating control data in the specific control protocol format with the control network.

16. The method of claim 15, wherein the translating step (b) comprises:

(b1) parsing out a plurality of data units in the generic control protocol format;

(b2) translating each of the plurality of parsed out data units from the

generic control protocol format to the specific control protocol format;

(b3) setting the values of a plurality of control network data units which correspond to the plurality of parsed out translated data units; and

(b4) means for initiating control network messages according to the values of the plurality of control network data units.

17. The method of claim 15, wherein the translating step (b) comprises:

(b1) fetching the values of a plurality of control network data units in the specific control protocol format;

(b2) packing the plurality of control network data units into a single message; and

(b3) encoding the single message into the generic control protocol format.

18. The system of claim 15, wherein each of the plurality of workstations comprise:

(a) at least one web browser program;

(b) a plurality of Hypertext Media Language pages supported by the web browser programs; and

(c) a plurality of embedded applets supported by the Hypertext Media Language pages.

19. The system of claim 18, wherein the embedded applets function as the means for communicating control data in the generic control protocol format between the server and the plurality of workstations.

20. The system of claim 15, wherein the translating means further comprises:
means of identifying input/output points;
means for identifying data points; and
means for identifying data formatting.

21. The system of claim 15, wherein the generic control protocol comprises:

means for providing node identification;

means for providing input/output point identification;

means for providing data types;

means for providing data units; and

means for providing data values.

22. A computer readable medium with computer instructions for providing computer network connectivity, the computer network including a control network and a plurality of workstations, the instructions for:

a) communicating control data in the generic control protocol format between the plurality of workstations and the server;

b) translating control data from the generic control protocol format to the specific control protocol format and from the specific control protocol format to the generic control protocol format; and

c) communicating control data in the specific control protocol format between the server and the control network.

23. The computer readable medium of claim 22, wherein the instructions for the translating means comprises:

means for parsing out a plurality of data units in the generic control protocol format;

means for translating each of the plurality of parsed out translated data units from the generic control protocol format to the specific control protocol format;

means for setting the values of a plurality of control network data units which correspond to the plurality of parsed out data units; and

means for initiating control network messages according to the values of the plurality of control network data units.

24. The computer readable medium of claim 22, wherein the instructions for the translating means comprises:

means for fetching values of a plurality of control network data units in the specific control protocol format;

means for packing the plurality of control network data units into a single message; and

means for encoding the single message into the generic control protocol format.

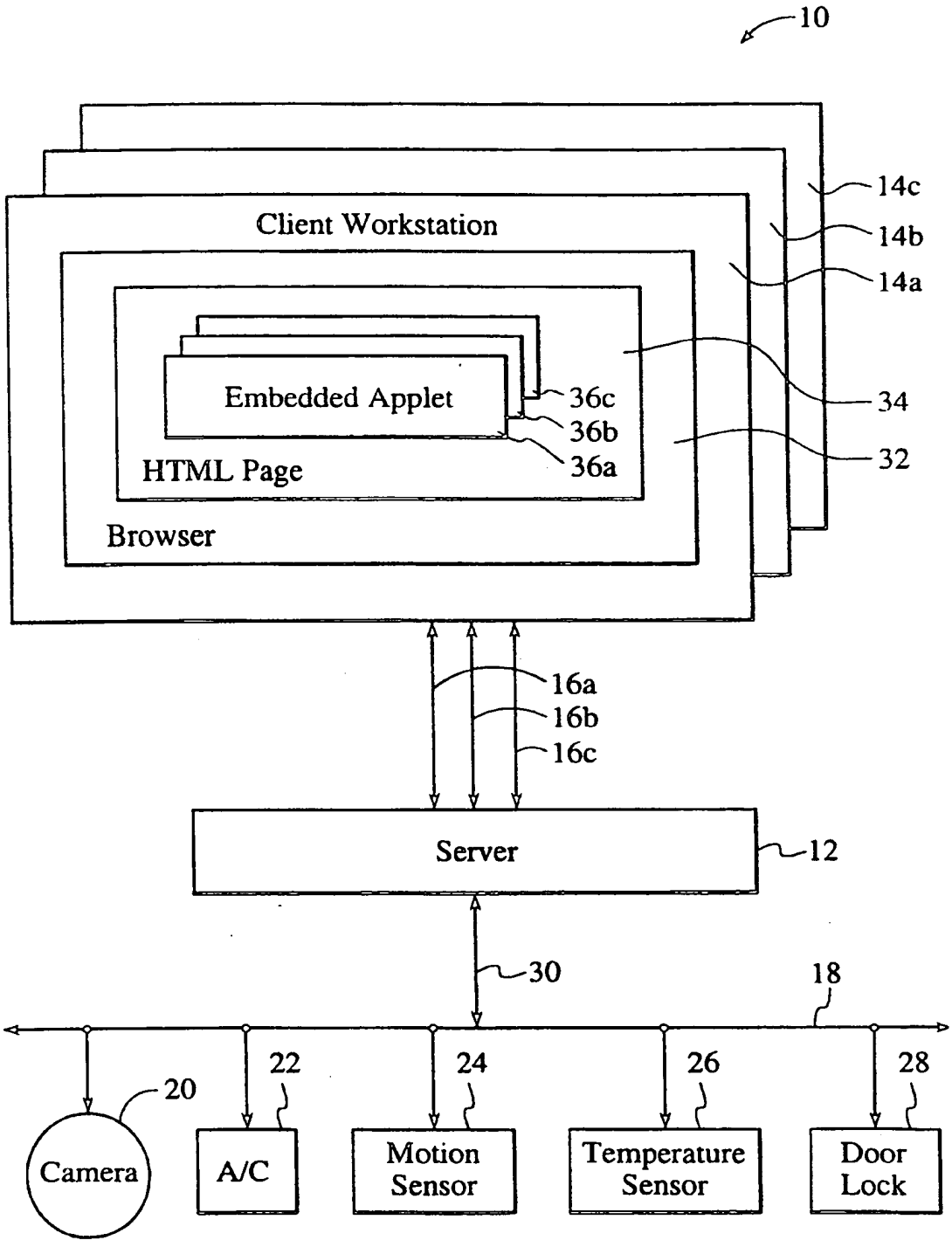

10
14c
14b
14a
Client Workstation
Embedded Applet
36c
36b
36a
34
HTML Page
32
Browser
16a
16b
16c
Server
12
30
18
20
22
24
26
28
Camera
A/C
Motion Sensor
Temperature Sensor
Door Lock

FIG. 1

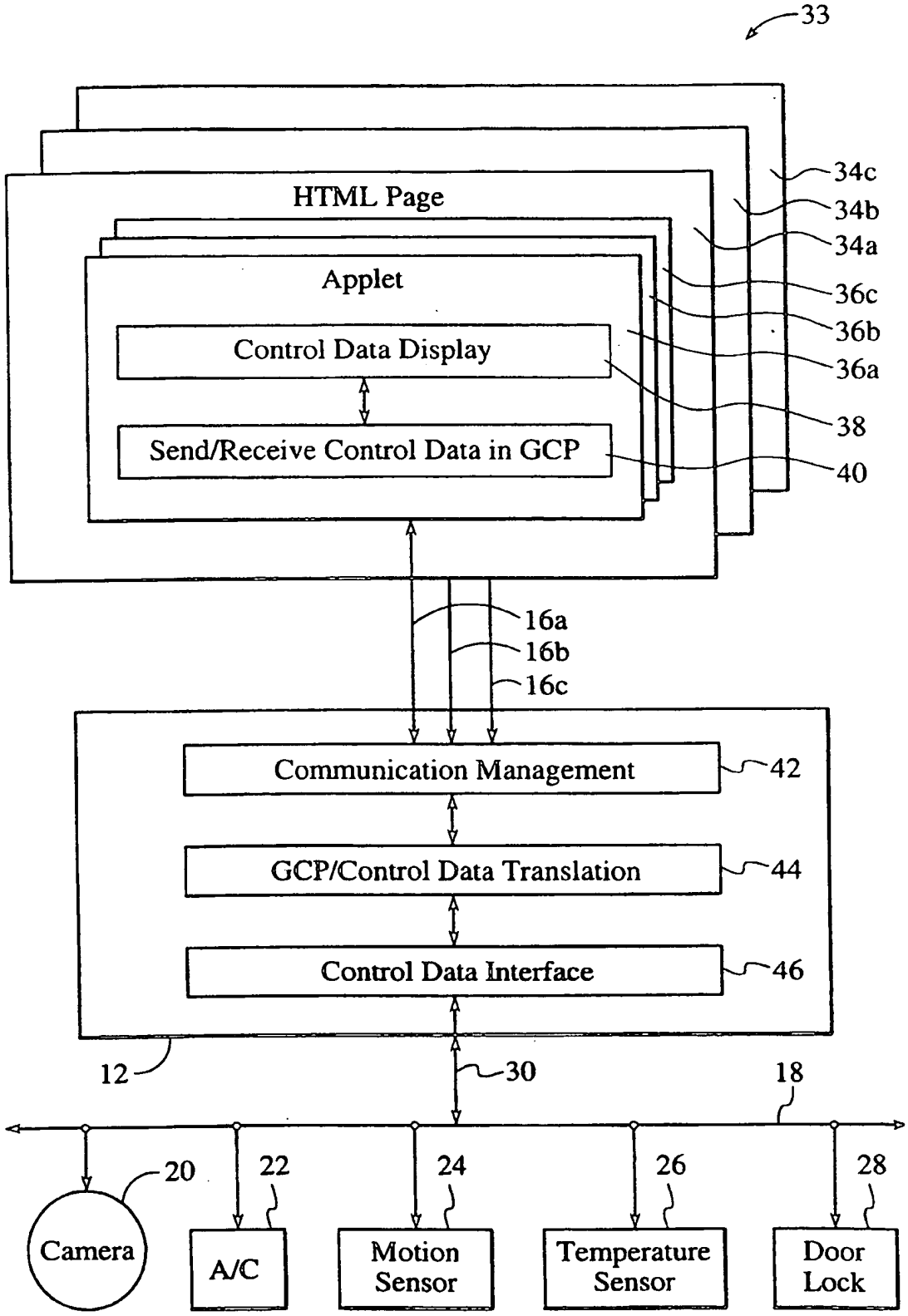

33
HTML Page
Applet
Control Data Display
Send/Receive Control Data in GCP
34c
34b
34a
36c
36b
36a
38
40
16a
16b
16c
Communication Management
42
GCP/Control Data Translation
44
Control Data Interface
46
12
30
18
20
22
24
26
28
Camera
A/C
Motion Sensor
Temperature Sensor
Door Lock

FIG. 2

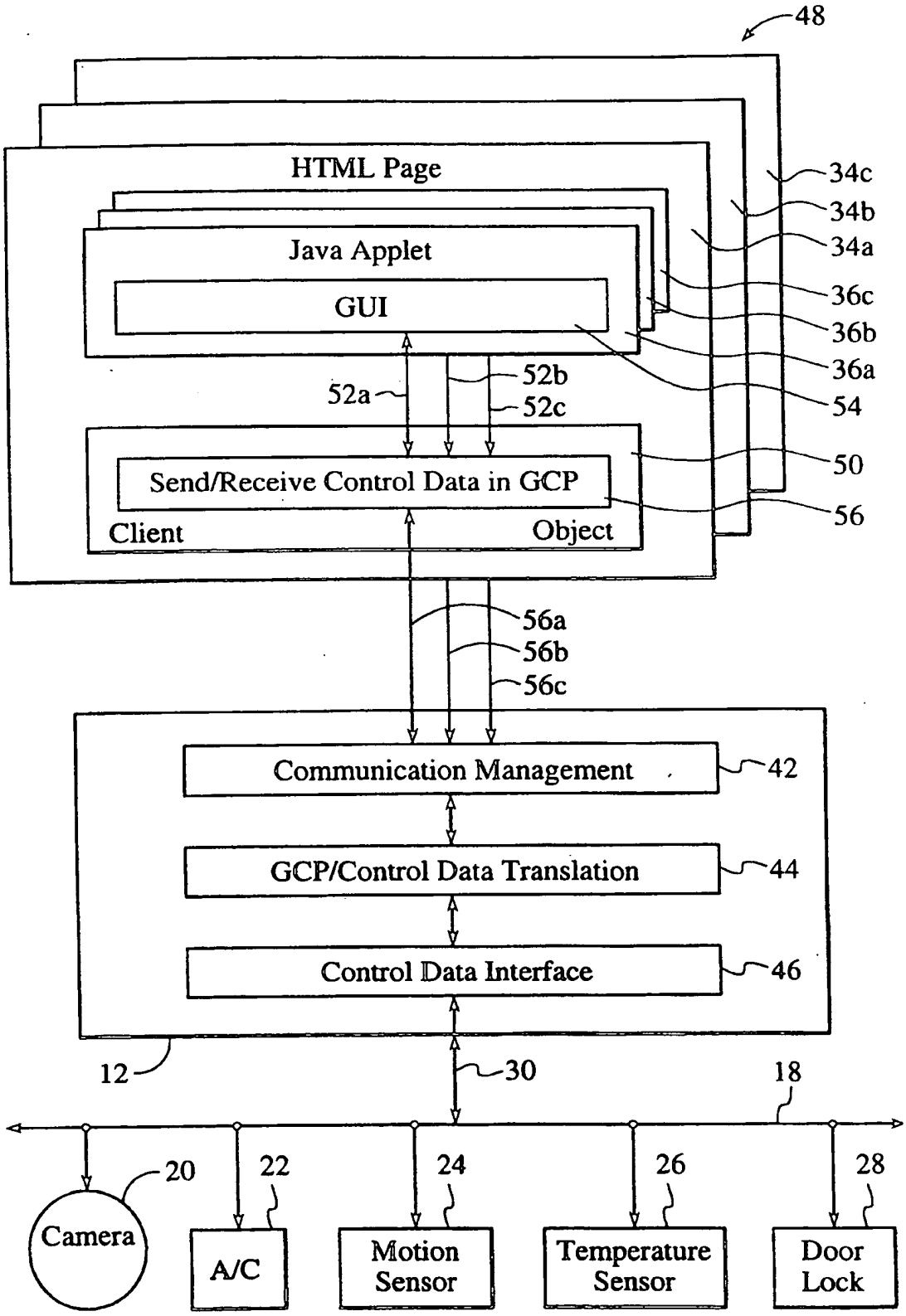

48
HTML Page
34c
34b
Java Applet
34a
GUI
36c
36b
36a
54
52a
52b
52c
Send/Receive Control Data in GCP
50
Client
Object
56
56a
56b
56c
Communication Management
42
GCP/Control Data Translation
44
Control Data Interface
46
12
30
18
20
22
24
26
28
Camera
A/C
Motion Sensor
Temperature Sensor
Door Lock

FIG. 3

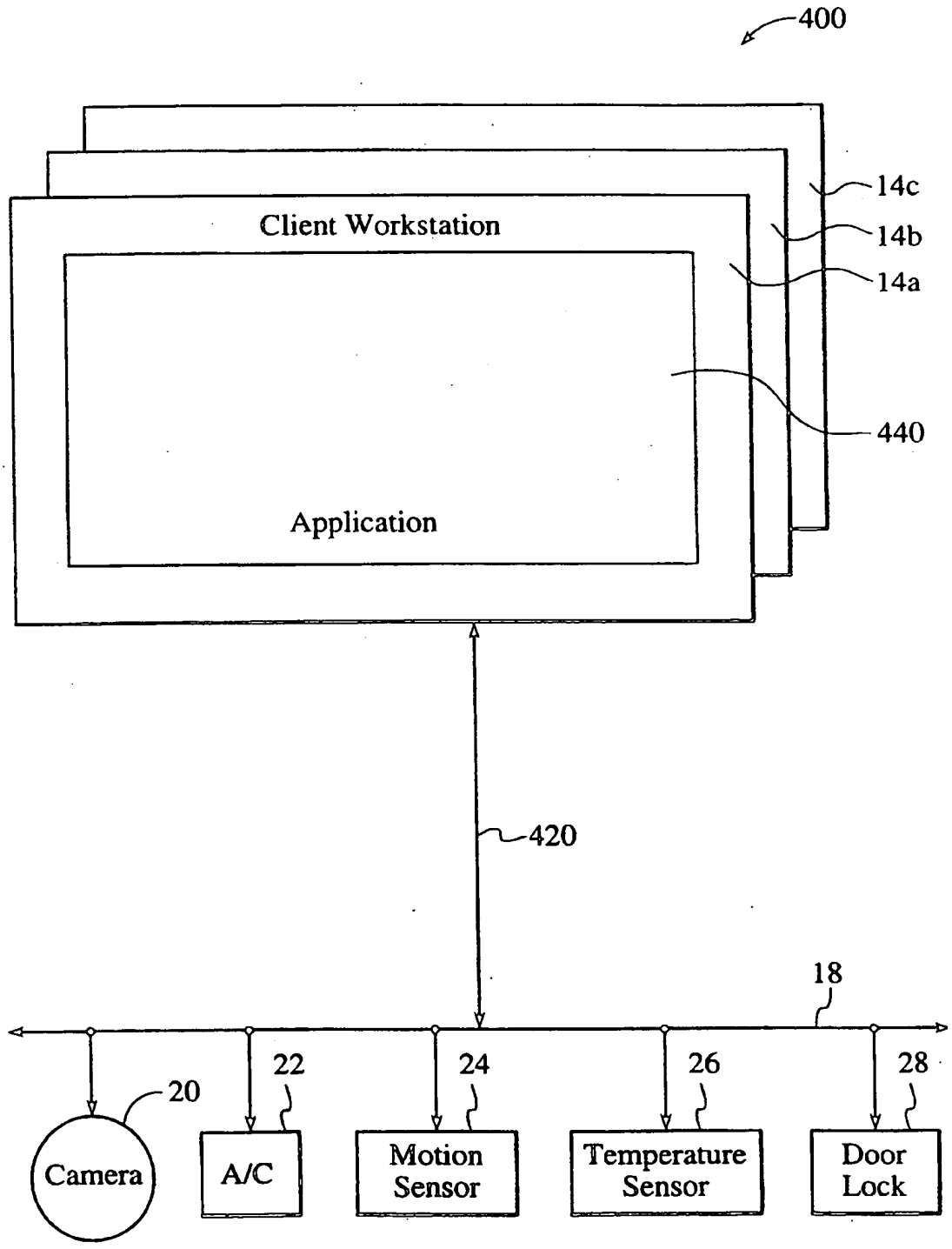


FIG. 4
(PRIOR ART)

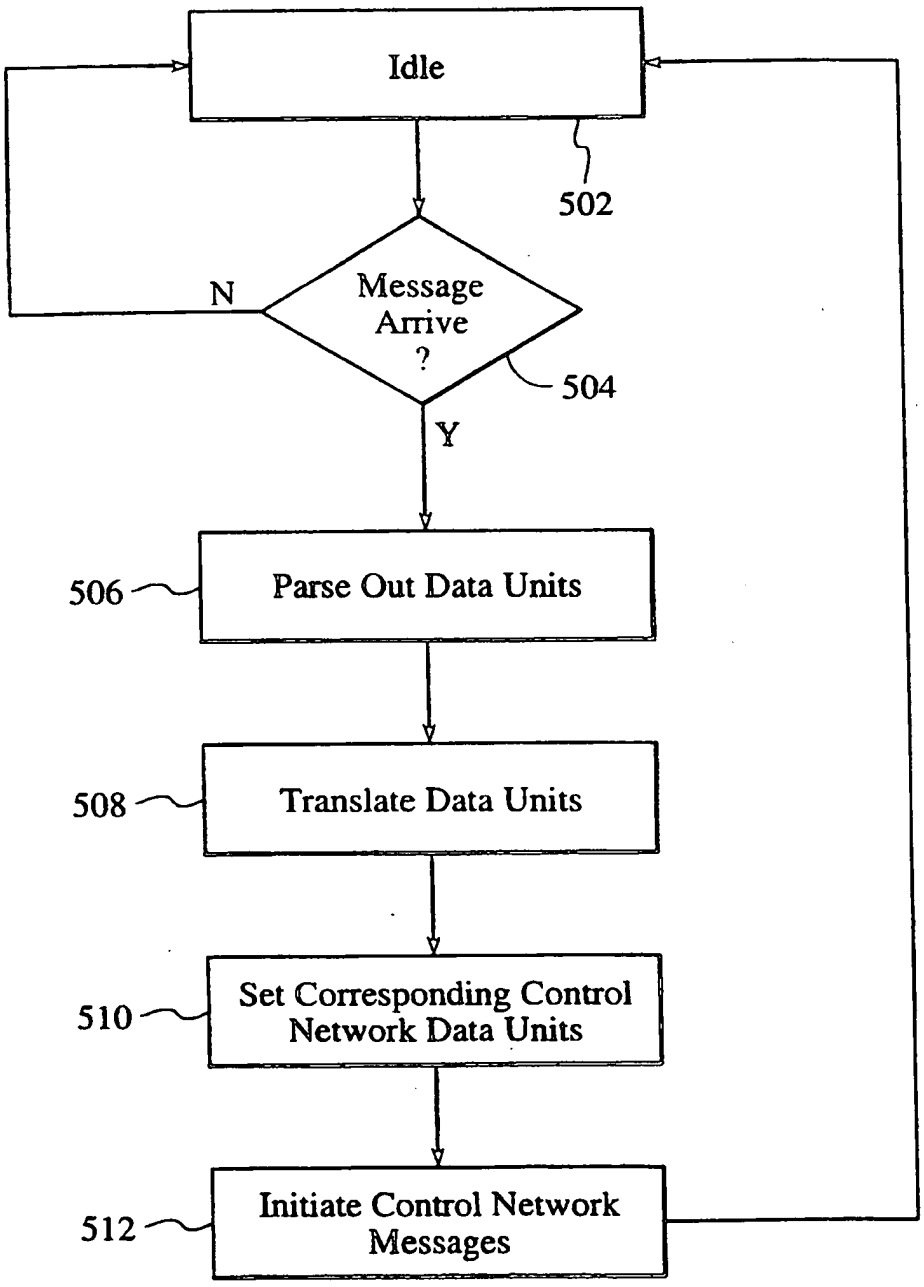

Idle
502
Message Arrive ?
N
504
Y
506
Parse Out Data Units
508
Translate Data Units
510
Set Corresponding Control Network Data Units
512
Initiate Control Network Messages

FIG. 5

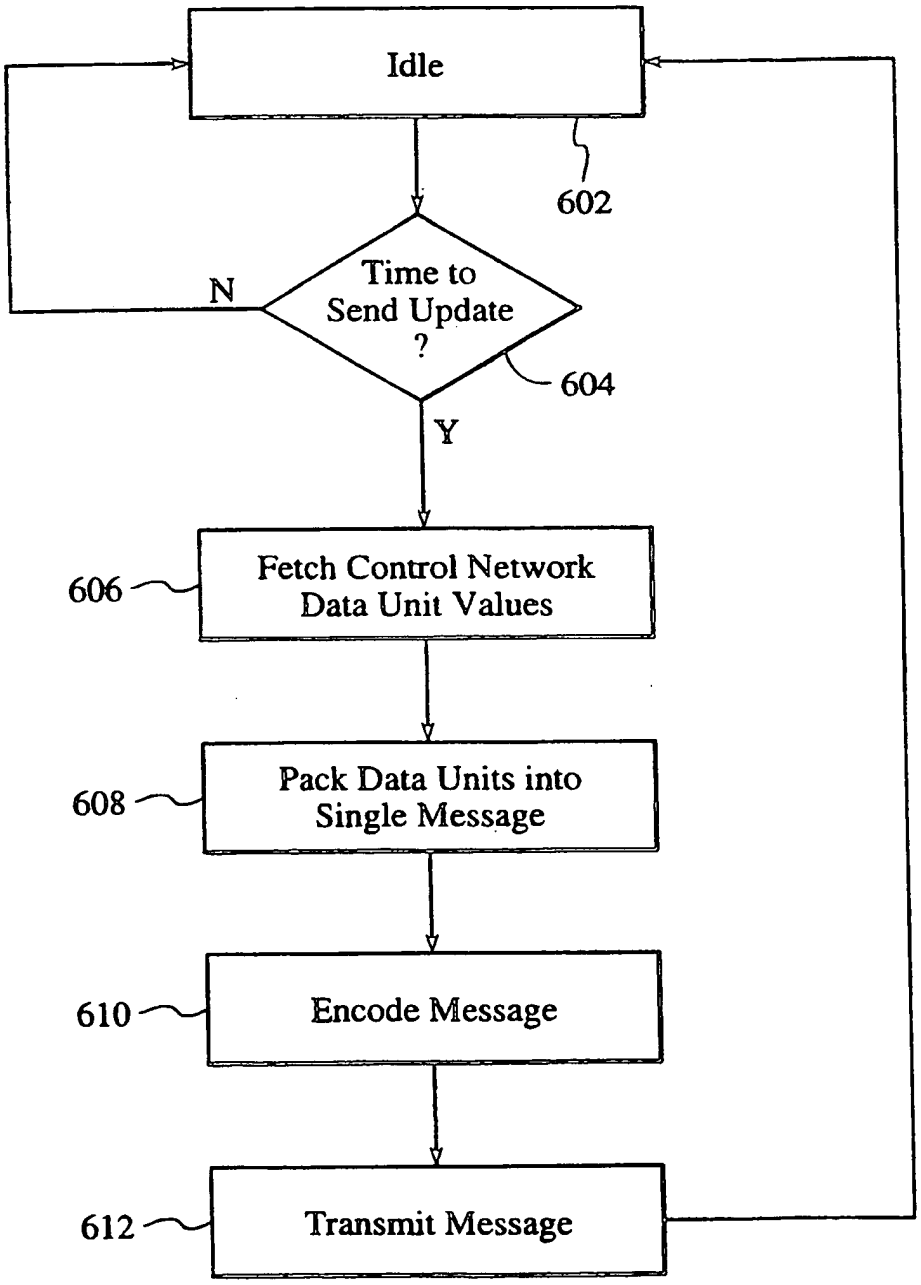

Idle
602
Time to Send Update ?
N
604
Y
606
Fetch Control Network Data Unit Values
608
Pack Data Units into Single Message
610
Encode Message
612
Transmit Message

FIG. 6

INTERNATIONAL SEARCH REPORT

Intern. al Application No
PCT/US 98/09925

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L29/06 H04L12/28 G05B19/042

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04L G05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	EP 0 814 393 A (TELIA AB) 29 December 1997 see abstract see column 1, line 41 - column 4, line 5 see figure 1 ---	1,8,15, 22
A	COHN M: "COMMUNICATIONS SERVICE REQUIREMENTS FOR DISTRIBUTED MONITORING APPLICATIONS" ADVANCES IN INSTRUMENTATION AND CONTROL, vol. 48, no. PART 01, 1 January 1993, pages 343-356, XP000434472 see abstract see page 351, paragraph 5 - page 353, paragraph 3 see figures 1-3 --- -/--	1,8,15, 22

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of theinternational search	Date of mailing of the international search report
29 September 1998	12/10/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lievens, K

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INTERNATIONAL SEARCH REPORT

Interna al Application No
PCT/US 98/09925

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 95 27357 A (D2B SYSTEMS CO LTD ;PHILIPS NORDEN AB (SE)) 12 October 1995 see abstract see page 1, paragraph 1 - page 2, paragraph 1 see page 5, paragraph 4 see figures 1,2	1,8,15, 22
A	EP 0 667 693 A (EMHART GLASS MACH INVEST) 16 August 1995 see abstract see column 1, line 1 - column 4, line 47 see figures 1,3,4	1,8,15, 22
A	LARSEN A K: "THE NEXT WEB WAVE: NETWORK MANAGEMENT" DATA COMMUNICATIONS, vol. 25, no. 1, 1 January 1996, page 31/32, 34 XP000545237 see page 31, left-hand column, paragraph 1 - page 34, left-hand column, paragraph 3	1,8,15, 22
A	PRESTON D J: "INTERNET PROTOCOLS MIGRATE TO SILICON FOR NETWORKING DEVICES" ELECTRONIC DESIGN, vol. 45, no. 8, 14 April 1997, pages 87-90, 92 - 94, XP000730016 see page 90, right-hand column, paragraph 2 - page 91, right-hand column, paragraph 3	1,8,15, 22

3

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Interna' al Application No
PCT/US 98/09925

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		JP 7267653 A	17-10-1995